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A Survey on different approaches of CBIR and their combinations

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***Abstract* — In CBIR main problem is to extract the image features that effectively represent the contents of an image in a database which may be difficult to use, using single feature. Whereas with combination of different features it would give efficient results. The different combination used maybe color-edge; color-shape-texture; color-texture; shape-texture. With more features different aspects of an image could be represented. In all the methods the texture is characterized by the statiscal distribution of the image intensity while the shape features are described with the segmentation of the region or the objects. The combination of CT has faster retrieval method which is robust to scale and translate objects in an image. Also the single feature like Gabor features has less precision than combination features of color moments and the Gabor texture. Also the experiments have proved to increase the efficiency of results.**

***Index Terms*—CBIR, Feature extraction, Precision, Recall**

I. INTRODUCTION

Information Retrieval is the field of knowledge that deals with the representation, storage, and access to information items. Particularly, when the retrieved information is a image or collection of images, this term is known as *Image Retrieval*. Image Retrieval Techniques started in 1979 when a conference on Database Techniques for Pictorial Applications was held in Florence [1]. Since then, the application potential of image database management techniques has attracted the attention of researchers. Early techniques were based on the textual annotation of images not on visual features. However, there were two significant limitations in the retrieval of images in text based systems. The first was in conjunction to the volume of the database. Manual annotation was such a time-taking and expensive task and it was unsuccessful with large image databases. The second limitation affecting the performance of the system was that the description of the images was found to be a highly subjective task that could generate different text labels to the same image. Such problematic image indexing methods have led to the rise of techniques for retrieving images on the basis of automatically-derived features such as color, texture and shape, generally referred to as content based image retrieval. [2]

A. Keyword Based Image Retrieval or Text Based approach

In the 1970s, the Keyword Based Image Retrieval system used keyword as descriptors to index an image [1]. In Fig.1 General Framework of keyword based image retrieval is shown.

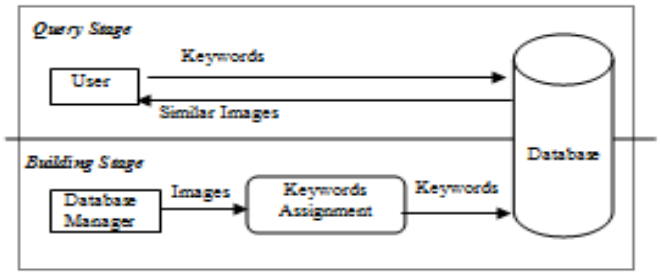

Fig.1 General Framework of Keyword Based Image Retrieval.[1]

Images stored in the database are examined manually in this technique and most appropriate keywords are assigned to describe their contents. The keywords are stored as the part of the attributes associated to the image. During query stage, user will fulfill the search criteria by providing one or many keywords. Then keyword matching process is performed to retrieve images associated with the keywords provided by the user that matches the search criteria.

B. Content Based Image Retrieval

In 1980s, Content-based image retrieval (CBIR) was introduced as an alternative to text based image retrieval [1]. Content-Based Image Retrieval is also known as Query by Image Content and Content-based Visual Information Retrieval. In CBIR, retrieval of image is based on similarities in their contents, like, textures, colors, and shapes etc., which are considered as the lower level features of an image. These conventional approaches for image retrieval are based on the computation of the similarity between the user's query and images. In CBIR each image stored in the database, has its features extracted and

compared to the features of the query image. Thus, broadly, it involves two processes, viz. feature extraction and feature matching [7].

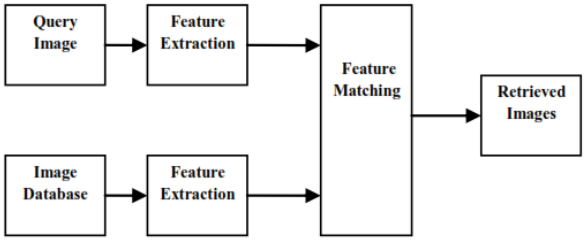

Fig.2 General Framework of Content Based Image Retrieval [7]

II. FEATURE EXTRACTION TECHNIQUES

Feature Extraction Techniques may include both text based features and visual features. Within CBIR visual feature are required to extract. In the visual features scope it can be classified as low level and high level features. The selection of the features to represent an image is one of the keys of a CBIR system. Because of perception subjectivity and the complex composition of visual data, there does not exist a single best representation for any given visual feature [4]. Multiple approaches have been introduced for each of these visual features and each of them characterizes the feature from a different perspective [4].Main three low level features are the Color, Texture and Shape.

A. COLOR FEATURE

Color features are the basic characteristics for the content of images. With the color feature human can identifies and distinguish between object and images. Colors are used in image retrieval because they are powerful descriptors and sometimes provide powerful information about images. To extract the color features from the content of an image, we need to select a color space and use its properties in the extraction. In common, colors are defined in three dimensional color spaces. In digital image purposes, RGB color space is the most prevalent choice [2].

Low level feature	Methods
Color	Color histogram
	Conventional color histogram
	Invariant color histogram
	Fuzzy color histogram
	Geometric moments
	Average RGB
	Color moments
	Color correlogram
	Color coherence vector

Table 1. Methods of Color feature

B. TEXTURE FEATURE

There is no formal definition for texture, but it can say that it provides the measure of properties such as smoothness, coarseness, and regularity. In addition, texture can be expressed as repeated patterns of pixels over a spatial domain. If the texture has exposed to some noise, the patterns and their repetition in the texture can be random and unstructured [2]. Because of there is no formal mathematical definition for texture, many different methods are proposed for computing texture but among those methods, no single method works best with all types of texture.

Low level feature	Methods
Texture	Discrete wavelet transform
	Gabor Wavelet Transform
	Haar Discrete Wavelet Transforms
	Ranklet Transform
	Discrete Fourier Transform
	Discrete cosine transform
	Hadamard Transform
	Gaussian Pyramid
	Laplacian Pyramid
	Steerable Pyramid
	Gabor Filter

Table 2. Methods of Texture feature

C. SHAPE FEATURE

Another important visual feature is Shape. Shape is the basic features used to describe image content. Shape's representation and description is a difficult task because when a 3-D real world object is projected onto a 2-D image plane, one dimension of object information is lost. As a result, the extracted image is only partially represents the projected object. To make the problem even to difficult, shape is often corrupted with noise, defects, arbitrary distortion and occlusion. As a result, shape properties play an important role in content based image database systems devised by computer vision researchers [14].

The reason for choosing shape feature for describing an object is because of its inherent properties such as identifiability, affine invariance, and reliability and occlusion invariance, thus shape of the object has proved to be a promising feature based on which several image classification and retrieval operations can be performed [14]. The shape descriptor are classified into two major kind namely Contour-based shape representation and description techniques and Region-based shape representation and description techniques

Low level feature	Methods
Shape	Fourier descriptors
	CSS descriptors
	Zernike moments
	Grid descriptors

Table 3. Methods for Shape feature

Different combinations of low level feature extraction :

A. In reference to this system [31], color and texture features are used. By applying block wise Discrete Cosine

Transforms (DCT) on the entire image, the texture features were extracted from the query image and by using moments of colors (Mean, Deviation and Skewness) theory, the color features were extracted from the retrieved image. Corel database of 1000 images has been used in the proposed system. The feature vectors of the query image were then compared with feature vectors of the database to obtain similar images. Comparatively better combined feature vector results were found when individual and combined vectors using the color and texture were computed. There is an efficiency of 60% in the proposed system and provides better results as compared to other CBIR feature extraction methods like Swain's Method, Funt's Method, Stricker's Method and Tamura's Method which has an efficiency of 48%.

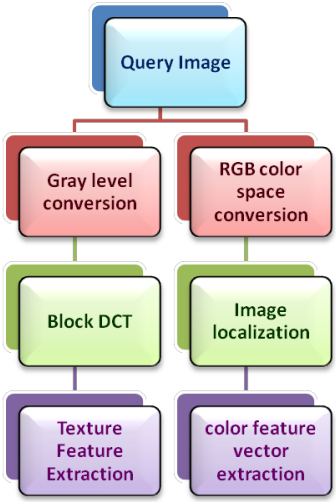

Fig 3. Block diagram of feature Extraction[31]

B. In this paper **[16]** a new region-based image retrieval technique called Principal Regions Image Retrieval (PRIR) has been proposed. This technique starts by segmenting an image to the most general principal regions and applies a fuzzy feature histogram to describe the color and texture properties of each segmented region. The proposed approach is started by generating a nearest neighbor graph for the segmented regions, and image rank is determined by applying a greedy graph matching algorithm with a modified scoring function. While keeping accurate precision, the proposed segmentation approach provides significant speedup towards the state of the art techniques. Moreover, this approach combines local and global description available to improve the results that are retrieved. Standard image databases are used to determine the performance of the system. Tests show that the specified approach enhances the accuracy of retrieval as compared to other approaches reported in the literature.

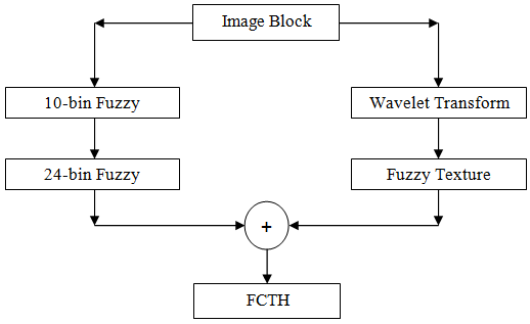

Fig. 4 A block diagram for the generation of FCTH.[16]

C. This paper [30] presents a unmatched technique that combines both the color and edge direction features for CBIR. In this method, a given image is divided into a sub-block which has the same size and then the extraction of color and edge direction features are carried out. Next, it constructs a codebook of color feature using clustering algorithm and then mapping of each sub-block to the codebook is done. At last, the color index codes are used to retrieve the image and the edge direction feature is used as the color feature's weight which belongs to the same color feature's sub-block. The experimental results show that the proposed algorithm is effective to image retrieval.

D. This paper [20] presents a CBIR system using the image features extracted by a color layout descriptor (CLD) and Gabor texture descriptor. CLD represents the spatial distribution of colors with a few nonlinear quantized DCT coefficients of grid-based average colors, whereas the Gabor filter works as a bandpass filter for the local spatial frequency distribution. These two are very powerful descriptors for CBIR systems. More accurate results are achieved when combining the color and texture features in CBIR. To compare the performance of image retrieval method, average precision and recall are computed for all queries. The results showed higher precision and recall values compared with the performance using other CBIR methods. Hence overall performance was increased, in spite of gray texture, color texture or color natural images.

E. In this proposed system [29], when an RGB query image is passed to the retrieval system, it is first transformed into HSV color image. Color feature is extracted from the query image and a color feature vector is formed. On the other hand, texture feature is extracted and texture feature vector is formed. After the extraction of color and texture feature vectors, the retrieval system combines these feature vectors and calculates the similarity between the combined feature vector of the query image and that of each target image in an image database, and the most significant target images are retrieved. This system increases the efficiency of the existing CBIR systems, while we look on the results it displays from the experiments.

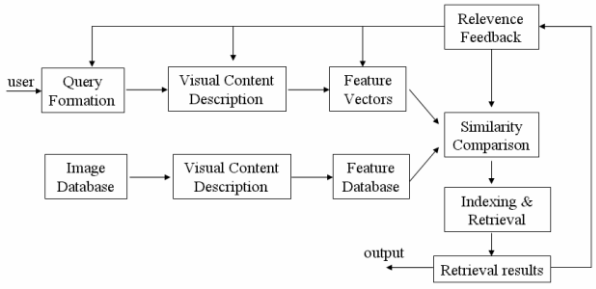

Fig.5 Block Diagram of CBIR System using color and texture feature[29]

F. To avoid the problems of legacy CBIR's retrieval system, this paper [2] proposes a new content-based image retrieval method that takes help of both color and texture feature. Color moment is calculated in HSV color space to extract the color feature from the image. Ranklet Transform is performed on the gray-scale image to extract the texture feature from the image. Texture moments help us in determining the texture feature from the ranklet images generated. Results show that

using both color and texture feature to describe the image and using them for image retrieval is more accurate than using only one of them.

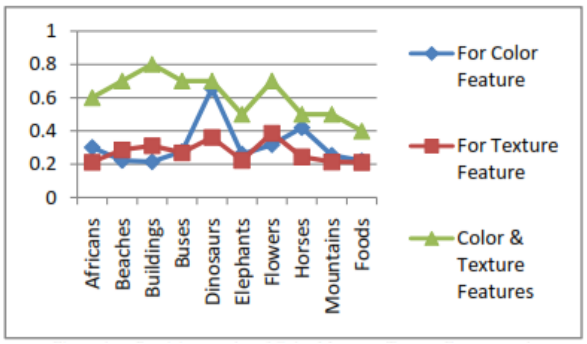

Fig. 5: Precision results of Color Moment, Texture Feature, and
Combination of Color and Texture [2]

G. Image retrieval based on triple combination of color, texture and shape is an emerging and wide area of research scope. In this paper [28] all the three i.e. color, texture and shape information are combined, and higher retrieval efficiency is achieved using dominant color feature. The images along with the complement of the same image are partitioned into non-overlapping tiles of equal size. Local descriptors of color, shape and texture are found in the RGB color space by the help of features drawn from conditional co-occurrence histograms between the image tiles and corresponding complement tiles. Integration of the above combination is performed, then it is cluster based on alike properties in the images. Based on five dominant colors retrieval of the similar images takes place. Histogram of the edges is created and Image information is captured in terms of edge images computed using Gradient Vector Flow fields. Shape features are recorded next by the help of invariable moments. The combination of the color, shape and texture features between image and its complement in conjunction with the shape features provide a robust feature set for image retrieval. The experimental result demonstrates the increased efficiency of the method.

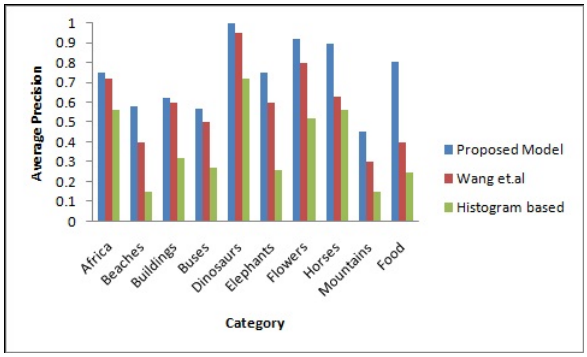

Fig 7: Average Precision[28]

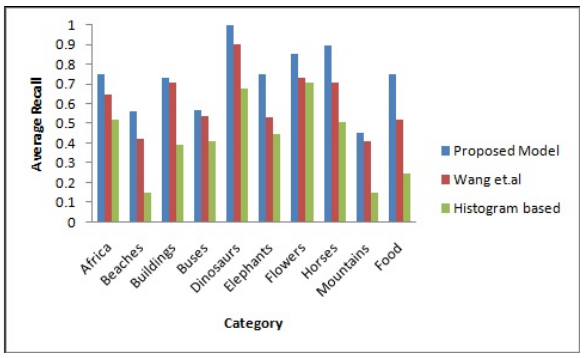

Fig. 8: Average Recall[28]

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